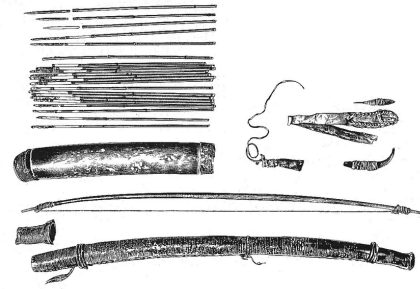


Ancient Archers



ANCIENT ARCHERS

They Forever Changed the World



LONNIE GOFF

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ABOVE: *San Hunting Kit. (Image Courtesy of KwaZulu-Natal Museum, South Africa.)*

COVER: *Prehistoric San Bushman Rock Art, Cederberg Mountains, Western Cape Province, South Africa. (Photo credit: https://commons.wikimedia.org/wiki/File:Sevilla_Rock_Art_9.JPG Author JessyAM (Licensed under CC BY-SA 6.0).)*

*In memory of Jim Hamm. He opened
the door to the Ancient Archers.*

*And in gratitude to geneticist
Dr. David Reich for his book
"Who We Are and How We Got Here"
He uncovered incredible secrets known only to the
Ancient Archers*

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AFRICAN MIGRATIONS

In ancient times our ancestors did not long survive when they entered the Land of the Neanderthal. A 210,000 year old partial and arguably modern human cranium was discovered in Southern Greece.¹ The Neanderthal evolved in Europe some 400,000 years ago and remained there another 170,000 years after this migrant disappeared.²

There was a migration from Africa into the Levant perhaps 120,000 years ago. This is the approximate age of robust modern humans uncovered in two caves in Israel. In a nearby cave evidence of Neanderthals was also found that dates to the same period.³ The tenure of the robust moderns in this region was short lived. The Neanderthals persisted in the Levant for another 65,000 years.⁴

Yet another migration happened around 55,000 years ago.⁵ This exit from Africa was across the Sinai and into the Levant.⁶ The Neanderthals were still there. This we know because the migrants interbred with them leaving a shadow of the Neanderthal in the DNA of all non-African people living today.⁷ (This was not the original sin, that would come 52,000 years later as proclaimed in the Book of Genesis.)

It would have been beneficial if a warning sign had been posted in the Sinai.

This is the gateway to a world you have never seen. It is incredibly beautiful but also has wild and dangerous things you know nothing about. In front of you is the Land of the Neanderthal. They live and hunt like the wolf.⁸ They are your cousins and think like you.⁹ They are armed and should be considered dangerous.¹⁰ One of their weapons is the javelin.¹¹ Good luck!

The Oracle of Sinai, 53,000 B.C.

This time something was different. This time it was the Neanderthal who would disappear. A small wave of Africans, likely no more than a few thousand, would amazingly become the founders of the entire non-African world.¹² When they were done there would be no Others.

55,000 YEARS AGO

Much is known about this migration because it was successful and it left a DNA trail to prove it. Evidence that this migration started as a small group is observable in the pronounced reduction of the genetic diversity in all of today's non-Africans. This kind of thing happens when a small population expands rapidly into a large, unpopulated territory. Furthermore, there is a continuous decrease in genetic diversity the farther one travels from Africa.¹

And once the Migrants passed through Neanderthal territory in the Near East and then into Southeast Asia their genetic trail shows that they interbred with yet another archaic human group, the Denisovans. The DNA of today's Indigenous Australians, among others, bears witness to this ancient tryst.²

Helicobacter pylori is a human-host gastric pathogen. It, too, went through a genetic bottleneck at the time of the Africa migration. Its greatest genetic diversity is found today in East Africa and its diversity decreases as its distance from East Africa increases. It left East Africa approximately 58,000 years ago.³

Two predators occupying the same ecological niche will be mortal enemies.⁴ Witness the lion and leopard, the wolf and coyote, the grizzly and black bear and predictably Neanderthals and Migrants. Europe is a big place especially if one is on foot. Yet in only a few thousand years after the Migrants entered Europe ~45,000 years ago, the Neanderthals were gone.⁵ Their 360,000 year reign had abruptly ended. (Note, this was not the first time the Migration entered Europe. It previously failed in Southern France ~54,000 years ago,... discussed later.)

Did the Upper Paleolithic sewing needle usher the Neanderthal into extinction? There is a lot to be said for warmer clothes but no matter how well we dressed our apparel surely did not intimidate the Neanderthal who were killers of giant straight-tusked elephants, woolly

rhinoceroses, woolly mammoths and each other.^{6,7} The Neanderthal's more immediate concern, after the Migrants arrived, was a new kind of sudden and unexpected death.

Something got invented in Southern Africa that predated both the Migration and the sophisticated Upper Paleolithic culture. It was a game changer. It was a work of genius.

THE INVENTION



Prehistoric San Bushman Rock Art, Cederberg Mountains, Western Cape Province, South Africa. (Photo credit: https://commons.wikimedia.org/wiki/File:Sevilla_Rock_Art_9.JPG Author JessyAM (Licensed under CC BY-SA 6.0).)

It was serendipitous that someone in Southern Africa dropped a used bone implement in a hearth and some 61,000 years later the South African archaeologist Dr. Lucinda Backwell would immediately recognize that this bone point was an arrowhead, the kind used well into historical times by the San People.¹

The ancient point was studied under a microscope. CT scans were used to look inside. Replicas were made by members of the San, tested on an animal carcass and then subsequently re-analyzed. The high velocity impact damage of the replicas was consistent with the ancient point.

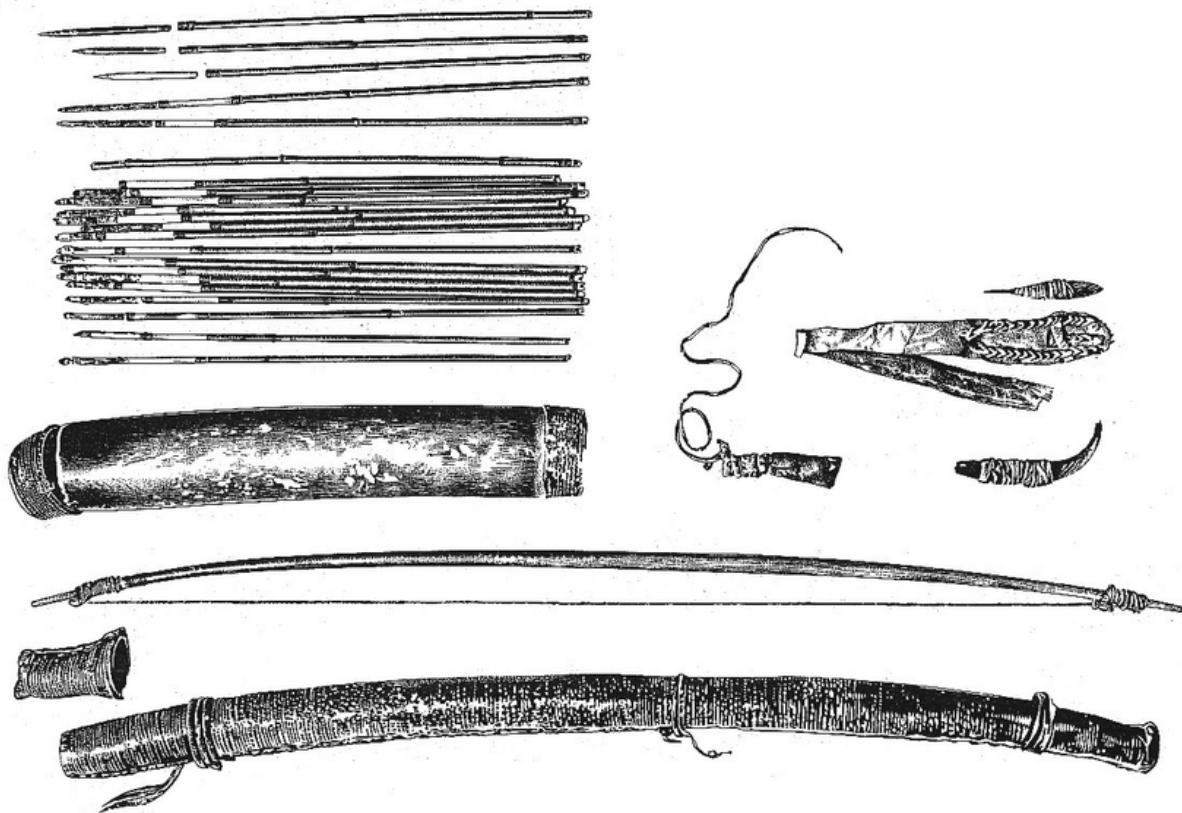
Researchers concluded that the ancient point was used as an arrowhead and later discarded in the hearth.²



Sibudu replicas (Photo: Courtesy of Dr. Lucinda Backwell, University of the Witwatersrand).

In 1926 a San hunting kit was found in a rock shelter in the Mhlwazini valley of South Africa. It was clearly constructed in the not too distant past because some of the arrowheads were made of iron. Other arrowheads were made of bone and are consistent with the ancient Sibudu arrowhead.³

The distance from Mhlwazini valley to the hearth in Sibudu Cave is 120 miles and 61,000 years.



1926 San Hunting Kit. (Image: Courtesy of KwaZulu-Natal Museum, South Africa.)

The Sibudu bone point is not, however, the earliest evidence of the bow-and-arrow. Also found in this cave were 64,000 year old small, sharp, stone blades with one dull side. Analyses of these small blades revealed that some had animal residue and high velocity impact damage that was deemed consistent with their use as arrowheads.⁴ At a different cave in South Africa 71,000 year old versions of these same projectiles were found.⁵ None of these sharp blades look much like arrowheads. (There is, however, evidence that this type of projectile may have killed a Neanderthal 50,000 years ago in Northern Iraq,... discussed later.)

The bottom most layer of Sibudu Cave is older than 77,000. Found in this layer were bifacial points the size of arrowheads. Some points retained residue from the Malvaceae shrub whose light, strong and straight stems were used well into historic times as arrow shafts.⁶



Examples of small blades used for arrowheads (Pitt Rivers Museum, Oxford, England). With one exception there are two blades on each foreshaft (the foreshafts were designed to be inserted into the hollow reed main shaft of an arrow). At least one of these foreshafts (4th from left) was made in historic times for its blades were chipped from bottle glass.⁷ (Photo: Courtesy of Dr. Justin Pargeter, New York University.)

The bow is not an obvious thing to make nor is it a simple thing to make. What inspired the "Genius of South Africa" to make such a weapon will never be known. Modern bowyers who re-create the ancient bows are keenly aware of the skill of the ancient bowyers.⁸ The single most important step is to know your wood for it must be able to withstand the compression force on the inside ("belly") and the stretching force on the outside ("back").

There are some 750 native tree species in North America.⁹ Existing museum artifacts reveal that eight of these trees are known to have been used by Native Americans to make their war/hunting bows.¹⁰ Only one tree in nearly a hundred species was good enough.

Two of the eight trees, the Osage Orange and Pacific Yew, excel. Even then the design of the bow is adjusted to reflect the different properties of the wood. The cross section of the bow made from the Osage orange is generally rectangular in shape while the cross section of the bow made from the softer yew tree is made thinner and wider.¹¹ Even the bow staves are cut differently. The yew stave includes the sapwood with the heartwood. When the stave is transformed into the bow, the heartwood becomes the belly and the sapwood the back. The Osage orange stave typically consists only of heartwood. The newer outer growth in the stave becomes the back while the older inner growth is used for the belly. But before work begins, the stave is cured. If not, the bow will have to be oiled (greased with animal fat) and re-tillered as it gets stronger with age.¹² For best results the Medieval English cured the wood for their longbows for 4 years.¹³

The other somewhat lesser trees all have their peculiarities. One design does not fit all. And no matter which wood is selected the cardinal rule of all bowyers, both ancient and modern, is do not cut through a growth ring on the back of the bow for that is where the bow will break.¹⁴ And after the stave is transformed into the bow it must be properly shaped. The Hadza of Tanzania place their bows into hot ashes and then use the fork of a tree to straighten the sides and to curve the back.¹⁵

The bow string is made from sinew, animal intestines or plant fiber. One method is to first strip the sinew or plant fiber down to 8 or 10 threads and then twist the threads together clockwise making sure that the thread lengths are staggered. After making a second string in the same manner the two strings are then twisted together counter clockwise.¹⁶

Making arrows is an art. As with bows the selection of wood for the shaft is critical albeit the selection criteria is different. Straight shoots of the desired wood should be cut in winter. The bark is then peeled and the diameter of the shaft is reduced and straightened by planing. The shafts are then bundled together and allowed to season for 2 to 6 months in a shady dry place. After seasoning, the arrows are reduced to their finished diameter by more careful planing. The finished diameter is measured by a shaft-sizer which is made of bone or wood with a hole the size of the finished diameter drilled through it. Once the arrow shaft has been reduced to the finished size it is straightened by carefully heating and then bending by hand.¹⁷

The preparation of feathers and their attachment to the shaft with sinew and glue as well as the manufacture of stone or bone arrowheads and their attachment to the shaft is a time consuming process and this description would be overly tedious. It is sufficient to say it takes a half day to make one arrow from a seasoned shaft.¹⁸

Ancient shaft-sizers made of bone are found in museums throughout the world and are labeled "baton de commandement", whatever that may mean. These are the micrometers of the ancient world and their purpose was to ensure consistent shaft size and therefore projectile performance. According to expert bowyer Jim Hamm he believed that most of these museum pieces were used to size shafts.¹⁹ The diameter of the holes in these artefacts do seem to cluster around two ranges, 5-9 mm and 16-30 mm. The smaller for arrow shafts and the larger for darts, javelins and spear shafts with the darts at the lower end of this range.



Baton de commandement found in Veyrier, Switzerland (Museum of Art and History, Geneva, Switzerland). It is ~13,000 years old with a 29 mm hole, the correct size for a spear. (Photo credit:

https://commons.wikimedia.org/wiki/File:B%C3%A2ton_de_commandement-MAHG_A-8816-P8050505-gradient.jpg Author Rama (Licensed under CC BY-SA 3.0 FR).)

In 1950 an elder of the Nez Perce Tribe of North America taught a young boy how to make their tribal bow. The boy learned by watching. The bow was short and powerful. It was made from the horn of the wild sheep. It was the same bow used by the ancestors of the Nez Perce to hunt buffalo. These bows had a draw weight of 70 - 75 pounds and shot fast.²⁰ If not for this one elder and one small boy the art of making this bow would have been lost. Some years later the tribe secured a grant for \$50,000 so that the then grown boy could show others the making of this bow. It takes a gap of only a couple generations before young boys have no one to watch.

SUCCESS

There is a body of research that concludes that innovation increases as populations grow. Research has also found that innovation can be lost when populations decline. This occurred when ancient sea levels isolated Tasmania from the Australian mainland. Archaeological evidence shows that this smaller population experienced a significant cultural devolution not seen in their more advanced Australian counterparts. A devolution that included the loss of fishing skills and the making of cold weather clothing.^{1, 2, 3}

The number of domestic and foreign patents granted by the U.S. Patent Office in 2020 is more than triple the number of patents granted in 1990 (before the coming of the Internet).⁴ The Internet is creating a global village of 8 billion people.

*If I have seen further, it is by standing upon the shoulders of giants.*⁵

Sir Isaac Newton 1675

All people living today share a common ancestor who lived no less than 320,000 years ago.⁶ For an unimaginable quarter of a million years our ancestors lived in small hunter-gatherer groups in Africa and progress was muted. There was, however, a dramatic population expansion in Southern and Eastern Africa broadly dated between 80,000 and 60,000 years ago.^{7,8} The bow was invented over 77,000 years ago in Southern Africa.⁹ According to one very renowned researcher:

*..it is reasonable to assume that the introduction of more effective hunting weapons would have substantially increased the efficiency and productivity of hunting activities and, therefore, the overall productivity of the food resources available to the human groups.*¹⁰

Sir. Paul Mellars, Cambridge University, 2006

The initial awakening of the Upper Paleolithic culture came thousands of years after the Migration left Africa. We have it backwards. The Upper Paleolithic, in all of its glory, was not the engine that drove world-wide success. It was, instead, its beneficiary. A benefit derived from a larger population whose distant roots were in Southern and Eastern Africa.

The Upper Paleolithic had more shoulders to stand upon.

THE HADZA

The Hadza are a small group of approximately 1,300 hunter-gatherers living in East Africa (Northern Tanzania).¹ They are distinct in appearance and language. Genomic comparisons show, for example, that they are more closely related to Europeans than they are to their next door neighbors. It was perhaps their ancestors that most amazingly migrated across the entire non-African world.² If so, some 6 billion people living today are the direct descendents of the ancient Hadza.

In their oral traditions the Hadza do not lay claim to the invention of the bow-and-arrow. It was in their third epoch that they began to make use of the bow. It was also in their third epoch that long distance trade was established.³ Southern Africa, where the bow was invented, lies adjacent to East Africa.

Hadza bows have a mean draw weight of 70 lbs (95 lbs measured max.). This is far beyond the strength and dexterity of nearly all modern archers who use traditional bows.⁴ Hadza boys get their first bows around 3 years of age. With endless practice they become experts. By age 5 or 6 they successfully hunt small rodents and birds. As they continue to age their bows get stronger and the game they hunt gets bigger.⁵

A Neanderthal would have been poorly advantaged against a Hadza expert with a 70 lb bow.



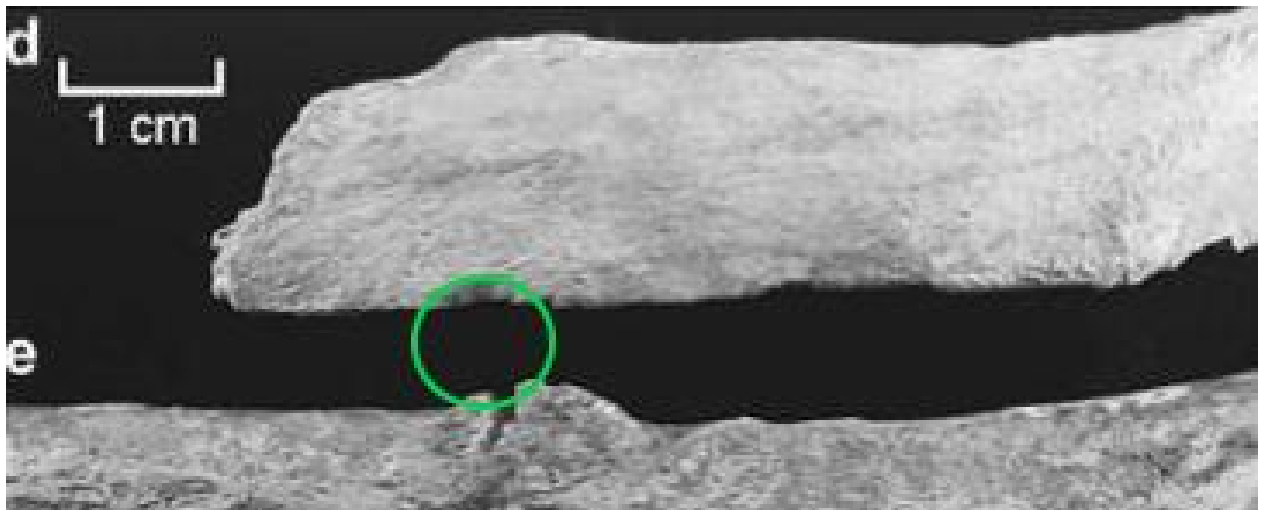
Hadza hunters practicing.

(Photo credit: <https://commons.wikimedia.org/wiki/File:Hadzabe1.jpg> Author Idobi (Licensed under CC BY-SA 3.0).)

EARLY MIGRATION OF THE BOW

Iraq (50,000 BP)

A 40+ year old Neanderthal died in Northern Iraq some 50,000 years ago.^{1,2} He did not die of natural causes. One of his ribs (L9) shows evidence of a partially healed wound and an adjacent rib (L8) shows blunt trauma. The wound is nothing more than a small nick 1/16" wide, 1/8" deep and 3/8" long (1.5mm x 3mm x 9.7mm).³



“d) lateral (external) view of L8 aligned in anatomical position with e) L9. Note the slight remodeling and involvement of inferior aspect of L8 in the injury”.⁴

(Photo: Courtesy of Dr. Steven E. Churchill, Department of Evolutionary Anthropology, Duke University.)

An approximate 9 mm green circle was added to the image to show the hypothetical alignment of an arrow shaft. The blunt damage to L8 is slight and smoothly curved. The distance between the two ribs is approximately 8 mm. The San hunters use arrow shafts 9 mm in diameter.⁵ Modern wooden arrow shafts range in size from 7.9 mm (5/16") to 9.1 mm (23/64") depending on the power of the bow.⁶

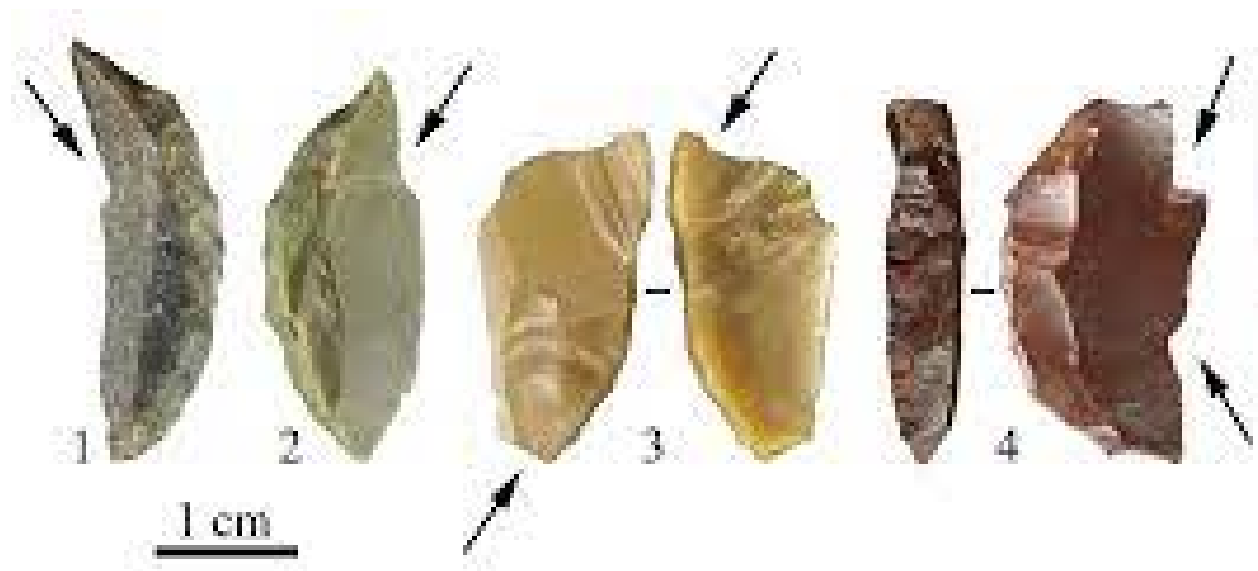
If the Neanderthal was exhaling when tragedy struck, the slight damage to L8 may have been caused by the arrow shaft as it pushed this rib up and out of the way as it passed into the lung.

Researchers concluded that the wound is most consistent with a lightweight, long-range projectile weapon. If correct, the nick did nothing to slow the projectile from entering the lung. In addition, an edge of the projectile's tip may have fragmented and temporarily lodged in the nick. If so, this would explain healing around the wound but none down inside the nick. The healing stopped when death came.

Spear and dart diameters are 2 to 4 times larger than arrow shafts and would have caused extensive damage to both ribs.^{7, 8} Only an arrow shaft is small enough to pass between two ribs and leave the type of damage displayed by the Neanderthal fossil.

The projectile's tip was never recovered. Since this fossil was discovered in 1957, some 50 years before ancient arrowheads that look little like typical arrowheads were discovered in South Africa, perhaps there is a small stone blade with a damaged edge sitting in a drawer in the Smithsonian.

The following photo shows impact scars and fractures on ~45,000 year old arrowheads recovered from Grotta del Cavallo in Southern Italy.⁹ The impact scars show that all of these projectiles were mounted longitudinally. They are all slightly larger than an arrow shaft resulting in the sharp side of these lithics acting as a cutting blade on one side of the shaft. It is this type of arrow that would explain why one rib of the Neanderthal was cut while the adjacent rib sustained only blunt trauma.



Damaged ~45,000 year old small blades from Grotta del Cavallo in Southern Italy showing impact scars and fractures.

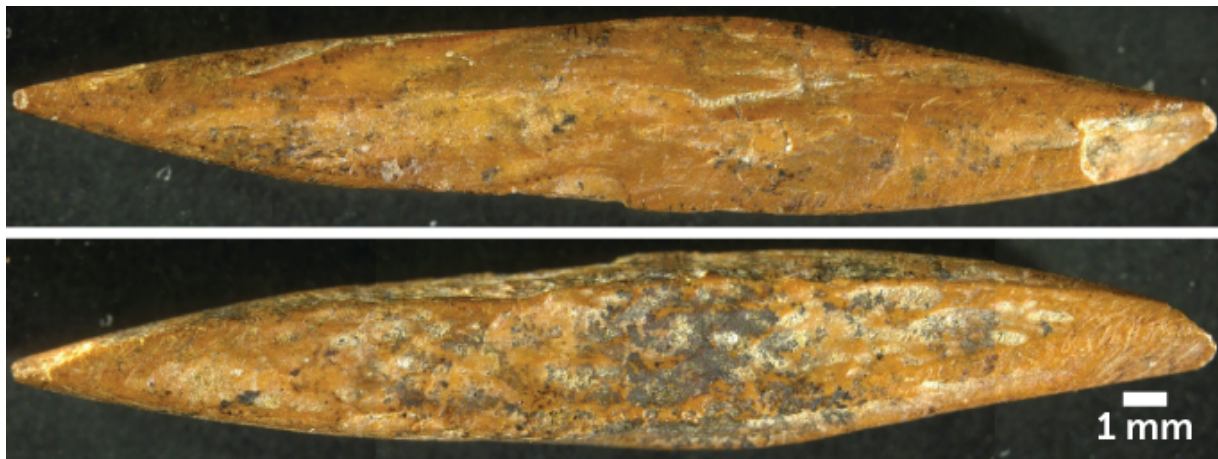
(Photo: Courtesy of Dr. Adriana Moroni, University of Siena.)

The blade that struck the ribs of the Iraqi Neanderthal was vertically aligned. Historically, the Comanches of the Great Plains used vertically aligned arrowheads when hunting game such as the buffalo in order to minimize the chance of the arrow being stopped by a rib. When at war their arrowheads were aligned horizontally for the very same reason.¹⁰ If the ancient blade had been horizontally aligned, evidence of this act of violence would have been lost to history.

Sri Lanka (48,000 BP)

Bone points have been found in Sri Lanka that date back 48,000 years and are consistent in design, size and weight with projectile points. It was determined by researchers that the majority of these points were used in high velocity projectile hunting. It was not, however, possible to differentiate between bow and spear use based solely on their damage.¹ A compelling case, however, can be made for the bow based on the hunting environment and the type of game harvested. The game targeted were prime-age monkeys and squirrels.² It is unlikely that spears or darts would have been successful in striking one of

these very quick and agile animals because the hunter's arm, while in the act of throwing, would have sent a visual alarm. In addition, an arrow travels roughly twice as fast as a dart and therefore has a flatter trajectory.^{3, 4} This is an obvious advantage when hunting in a dense rainforest. And more importantly, the arrow can be shot from concealment.



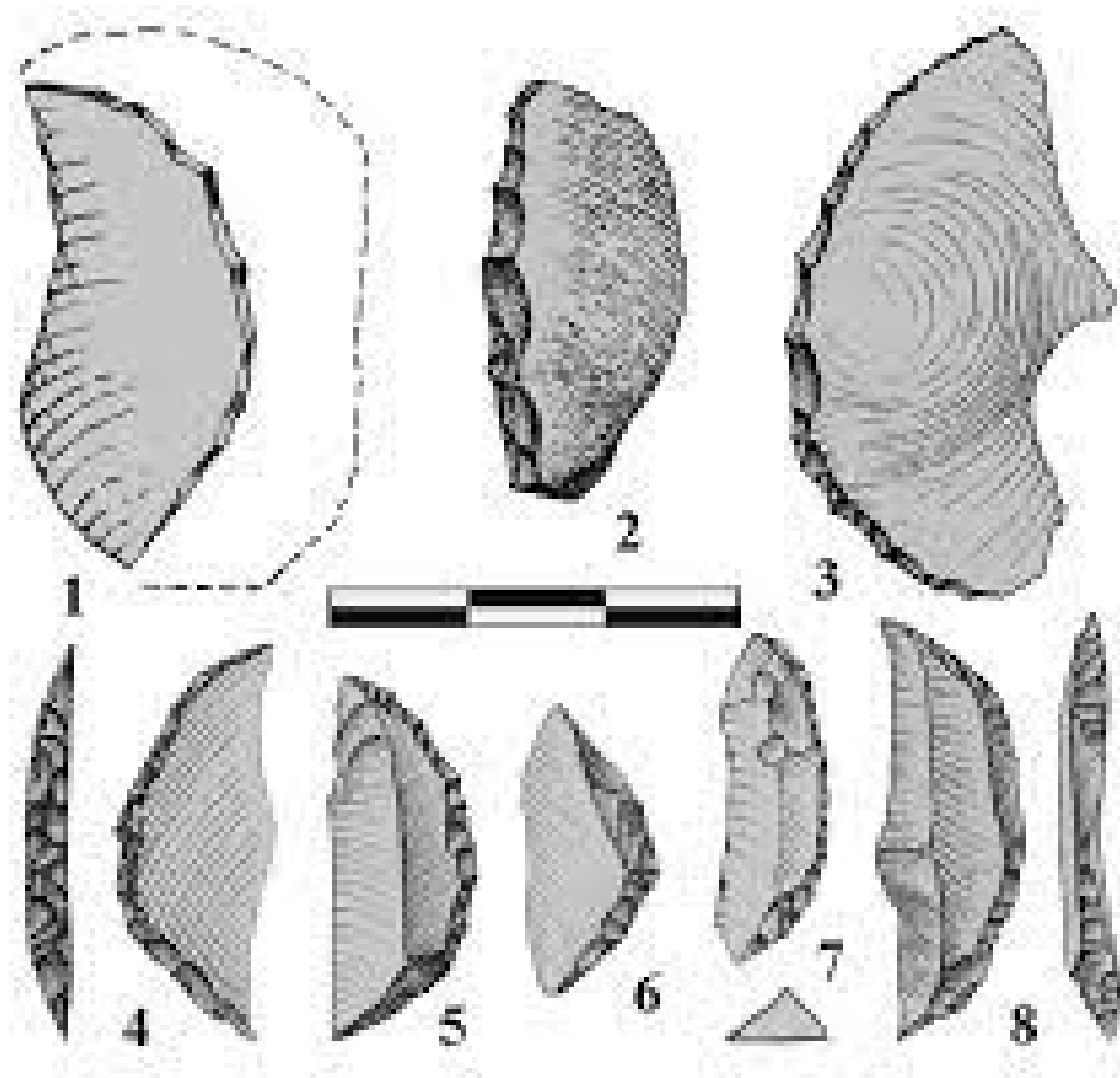
Microscopic analyses of this ~48,000 year old bone point (shown from two sides) indicate it was likely an arrowhead.

(Photo: Courtesy of Dr. Michelle Langley, Griffith University in Brisbane.)

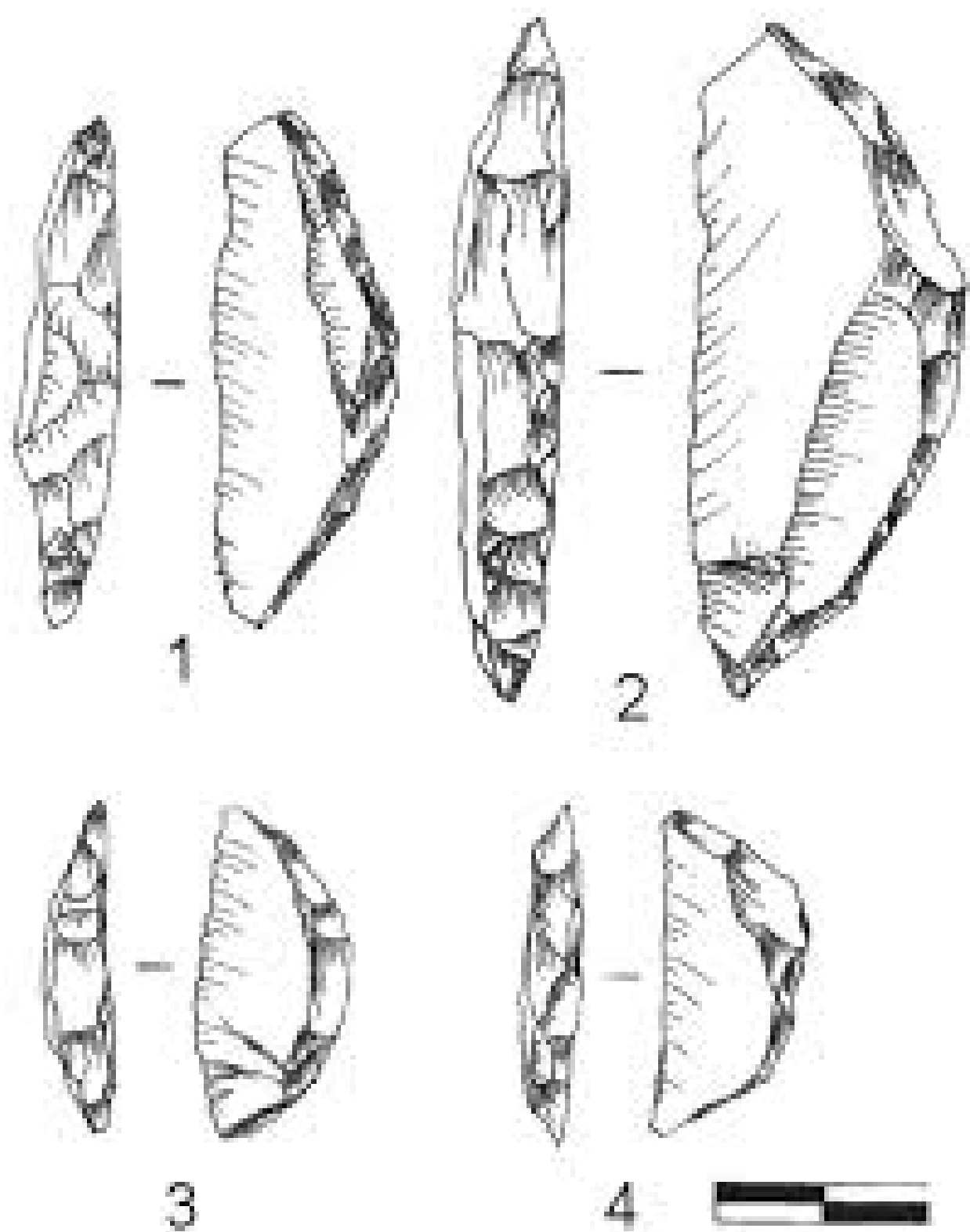
Italy (45,000 BP)

On the lower coast of Italy early evidence of the Migration has been found. It arrived some 45,000 years ago. The technology the Migrants brought with them has undeniable similarities to far older South and East African toolkits. For example there is a rock shelter in Tanzania, dated between 57 and 49 thousand years ago, with tools closely related to the Italian toolkit (this rock shelter is located in the heartland of today's Hadza).¹ There is also the Sibudu Cave in South Africa. The small blades ("backed pieces") in the Italian toolkit are closely patterned after the 64,000 year old Sibudu arrowheads (see following drawings). Furthermore some of the Italian blades show

evidence of high velocity impact damage consistent with damage found in the Sibudu Cave projectiles.^{2, 3}



*45,000 year old blades from Grotta del Cavallo, Italy.
(Drawing: Courtesy of Dr. Adriana Moroni, University of Siena.)*



*64,000 year old Sibudu Cave arrowheads.
(Drawing: Courtesy of Dr. Lyn Wadley, University of Witwatersrand.)*

Evidence is so far lacking that this toolkit ever passed through the Near East.⁴ Perhaps, instead, it came by sea. If so, this should not be surprising. Some 5,000 years earlier there was a purposeful and successful voyage by "Eastern" Migrants to the western coast of Australia/New Guinea.⁵

Japan (38,000 BP)

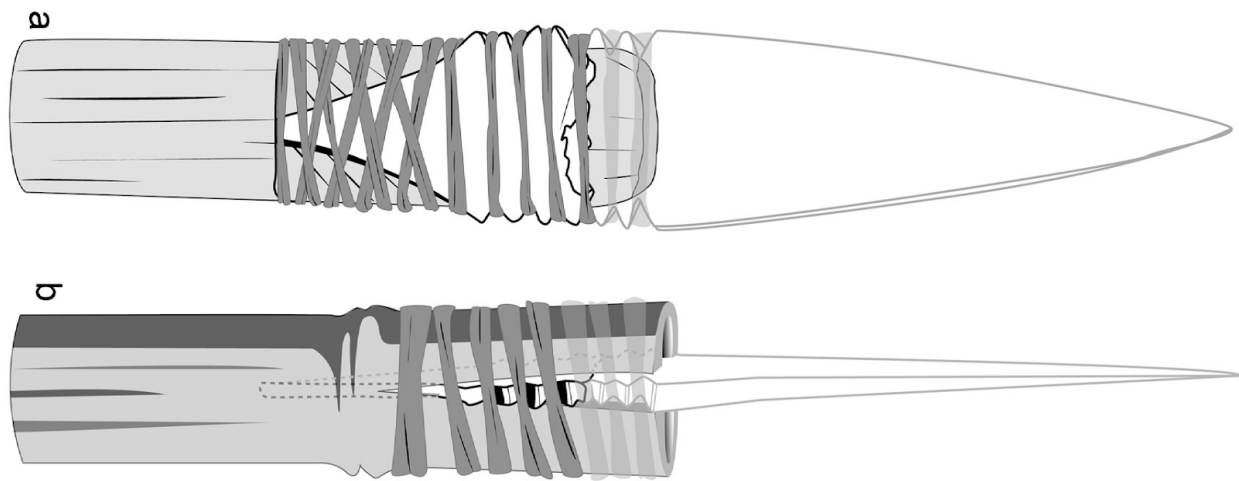
The first moderns to enter Japan did so around 38,000 years ago. There are numerous sites that date from this period that contain small blades of similar size to the African and Italian blades although they are shaped differently. Replicas of these small trapezoids were made and experiments were conducted. The damage observed in some of the ancient lithics could only be reproduced when the replicas were shot from a bow. Based on the early age of these sites and the widespread presence of these blades the researchers concluded that the early migrants had the bow-and-arrow in their possession when they entered Japan.¹

Timor Island (35,000 BP)

On Timor Island a partial ~35,000 year old bone projectile point was found. Only the side notched base of this point remained. The section of the point that extended beyond the base was missing, perhaps broken by impact. The base was likely designed to be hafted in such a manner that the notched sides extended beyond the diameter of the shaft. Resin and tough cordage made from animal or plant fiber would have been used to secure the base to the shaft.¹ Based on the width of the break and the distance between the notches the diameter of the shaft would have been 8 to 9 mm. This is consistent with the size of modern wooden arrow shafts. It is also consistent with the diameter of the reed shafts used by the San.

Some North American arrowheads have a single notch on each side. In order to mount this type of arrowhead an insert deeper than the distance from the bottom of the base to the top of the notches is cut into the solid head of the shaft. This is time consuming with flint tools.² By North American standards the cut required for the Timor point would have been bigger than most.

If, however, the Timor point was installed in a reed shaft, which is hollow, and if the missing end of the blade was barbed, this would suggest a possible use for this unusual point. It would have been an arrowhead used for bow fishing. It would have been an arrowhead that required a very firm attachment to the shaft.

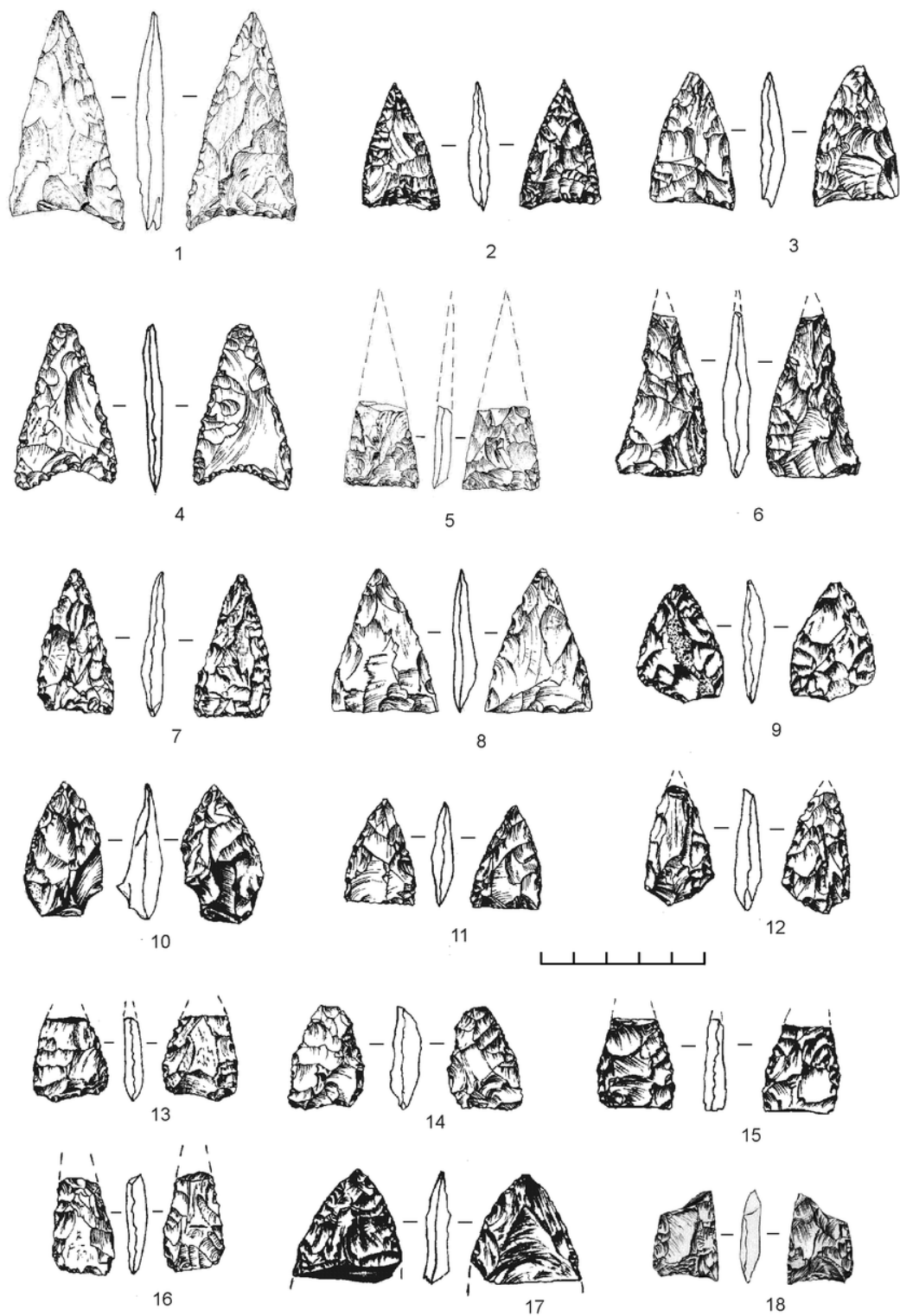


Shown are two different ways the projectile base may have been hafted and how its missing end was perhaps shaped.³

(Drawing: Courtesy of Dr. Sue O'Connor, Australian National University.)

Russia (29,000 BP)

In north western Russia some 700 miles north and east of Moscow is an Early Upper Paleolithic site (Garchi I) that dates to around 29,000 years. Found at this site were numerous bifacial triangular projectiles.^{1, 2}

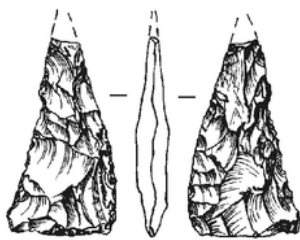


Ancient Russian bifacial triangular projectiles

(Drawings: Courtesy of Dr. Pavel Yurievich Pavlov, Institute of Language, Literature and History, Komi Science Center, Ural Branch, Russian Academy of Sciences.)

Arrowheads of similar size and shape have been found throughout North America from the Bering Sea and Canadian Arctic to the Pacific Northwest, Middle Atlantic, Western States and Northern Mexico. Some of these North American arrowheads are 200 years old, some over 10,000 years old.³

Shown next, in approximate scale, are two of the 18 ancient Russian projectiles alongside photos of a ~13,500 year old Texas arrowhead⁴ and a ~1100 - 200 year old arrowhead from the Columbia River Basin.



6



Russia ~ 29,000 BP
(~28 mm x +51 mm)

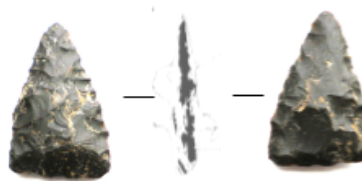
Texas ~ 13,500 BP
(~32 mm x +53 mm)

(Photo: Texas arrowhead, courtesy of Dr. Michael R. Waters, Center for the Study of the First Americans, Texas A&M University.)



11

Russia ~ 29,00 BP
(~23mm x ~33 mm)



Columbia River Basin ~1100 - 200 BP
(~22mm x ~33 mm)

(Photo: from the author's collection.)

SOUTHERN FRANCE

The Neanderthals initially made a successful and long lasting comeback against the Migrants.

Migrants entered the Rhone Valley of Southern France at about the same time that they entered the Levant ~54,000 years ago. Archeological evidence reveals that the Migrants quickly replaced the Neanderthals and shortly thereafter they, in turn, were quickly replaced.¹

Some 10,000 years later the Migrants were back.² They came with a knowledge gleaned from thousands of years of conflict with the Neanderthal. More research may also suggest that they also came with the wolf-dog.³ For the Neanderthals of the Rhone Valley the Migrants would have been a long forgotten memory. A forgotten memory that this time would usher them into extinction.

AUSTRALIA

Australia is surrounded by people with a long history of the bow (Timor Island, New Guinea, Solomon Islands, Fiji, etc.). Evidence is, however, lacking that this weapon was ever used on the Australian continent. In 1769 Captain Cook sailed from Tahiti to New Zealand and then up the East Coast of Australia. He did not see a single example of the bow-and-arrow until he reached a small island close to the northernmost tip of Australia.¹ The Indigenous Australians on this island made use of outrigger canoes with sails to conduct a robust trade in the Torres Strait.² New Guinea is only a hundred miles away from the man with the bow. The possession of a bartered bow is trivial compared to knowing how to make it.

Sometime between 50,000 and 45,000 years ago the ecosystem of Australia dramatically shifted from a nutritious tree and shrub savanna to its current desert scrub environment.³ For 45,000 years the Indigenous Australians have made use of the same trees that grow today, about 450 species.⁴ Information posted online by modern bowyers suggest that 12 of these trees can be made into "serviceable" bows.⁵ The bows of the Hadza of East Africa have a draw weight over 70 lbs. The Nez Perce bows were as powerful. Well into the 1950's the Liangulu of Kenya used bows in excess of 100 lbs to hunt elephants (the most powerful measured was 131 lbs).⁶ Medieval English longbows had draw weights well over 120 lbs.⁷ It is not known if there is an Australian tree that can be made into bows with similar power, durability and performance. Even the Native Americans of the vast Rocky Mountain and Great Basin regions of North America had to import bow-worthy wood from great distances or else make their bows from the horns of the buffalo or wild sheep.⁸

Australia is a very big place and none of the twelve "bow-worthy" trees are ubiquitous. Only one, the Brown Mallet, grows on the West Coast and it is found at the bottom southwest corner of the continent. Another tree, the Desert Oak, is found scattered in the central region

of the outback. The remaining 10 are more or less clustered along the East Coast.

Multiple ancient routes to the then giant continent that included both Australia and New Guinea have been modeled by researchers to show where the Migrants likely arrived. All the hypothetical routes terminated somewhere in the uppermost region of the vast continental West Coast.⁹

Ancient sites suggest that the Migrants first settled Australia along its coasts and that it took perhaps a 1,000 years (over 40 generations) to reach the bottom of the West Coast.¹⁰ As demonstrated by the Nez Perce of North America it would take a gap of only a couple generations for a tribe to lose the art of bow making. By the time the Migrants came upon the Brown Mallet, bow making was a long forgotten art.

Of immediate concern to the Migrants were some very big, very strange and very dangerous animals. There were 20 foot long carnivorous lizards, lion-like mammals with crushing jaws, 1,000 pound meat eating birds, enormous three ton wombats with clawed feet, very fast 20 foot long land-dwelling crocodiles and more.¹¹

The Migrants arguably came ashore with a second weapon. Something that was far easier and less time consuming to manufacture. Something that did not require a wood with overly critical properties. Something that would kill from a distance, albeit not from concealment.

Researchers in Germany conducted experiments on wild boar carcasses in order to observe the damage caused by thrusting spears and spearthrower darts. European spearthrower competitors were recruited for this experiment. Although the average velocity of the darts was half that of a Medieval English longbow, the energy generated at short range (10m) by the fastest dart thrower was equivalent to the longbow.^{12, 13} In expert hands, at short range, the spearthrower is a devastating weapon.

A 50 year old hunter was buried in southeast Australia about 42,000 years ago. The head of the radius of his right arm was extensively damaged. The elbow had lost over 60% of its normal bend. Rotation of the lower arm would have been impossible. In total, the right arm had a distinctive set of degenerative features that match and are unique to a lifetime of strenuous and repetitive use of the spearthrower.^{14, 15} This man did not invent the spearthrower.

Cross-section analyses of stone points recovered from a cave in Ethiopia reveal that these points were too small for spearheads and too big for arrowheads. They were, however, the correct size for spearthrower darts. These points predated the African Migration by some 5,000 to 15,000 years.¹⁶ Evidence of the bow-and-arrow uncovered in Sibudu cave in South Africa predates the Migration by 20,000 years.

The bow and spearthrower were survival's handmaidens. They would not have been casually abandoned. They are found all over the non-African world. When the First People landed in Australia the loss of bow making would not have been catastrophic. They would still have been armed and lethal.

PEACEMAKER

Colonel Richard Dodge was a career officer in the U.S. Infantry from 1848 to 1895. During this time he served more than 30 years on the western frontier among the Native Americans. He observed the following:

He will grasp five to ten arrows in his left hand, and discharge them so rapidly that the last will be in flight before the first has touched the ground, and with such force that each would mortally wound a man at twenty or thirty yards.¹

Col. Richard Dodge, 11th Infantry US Army 1882

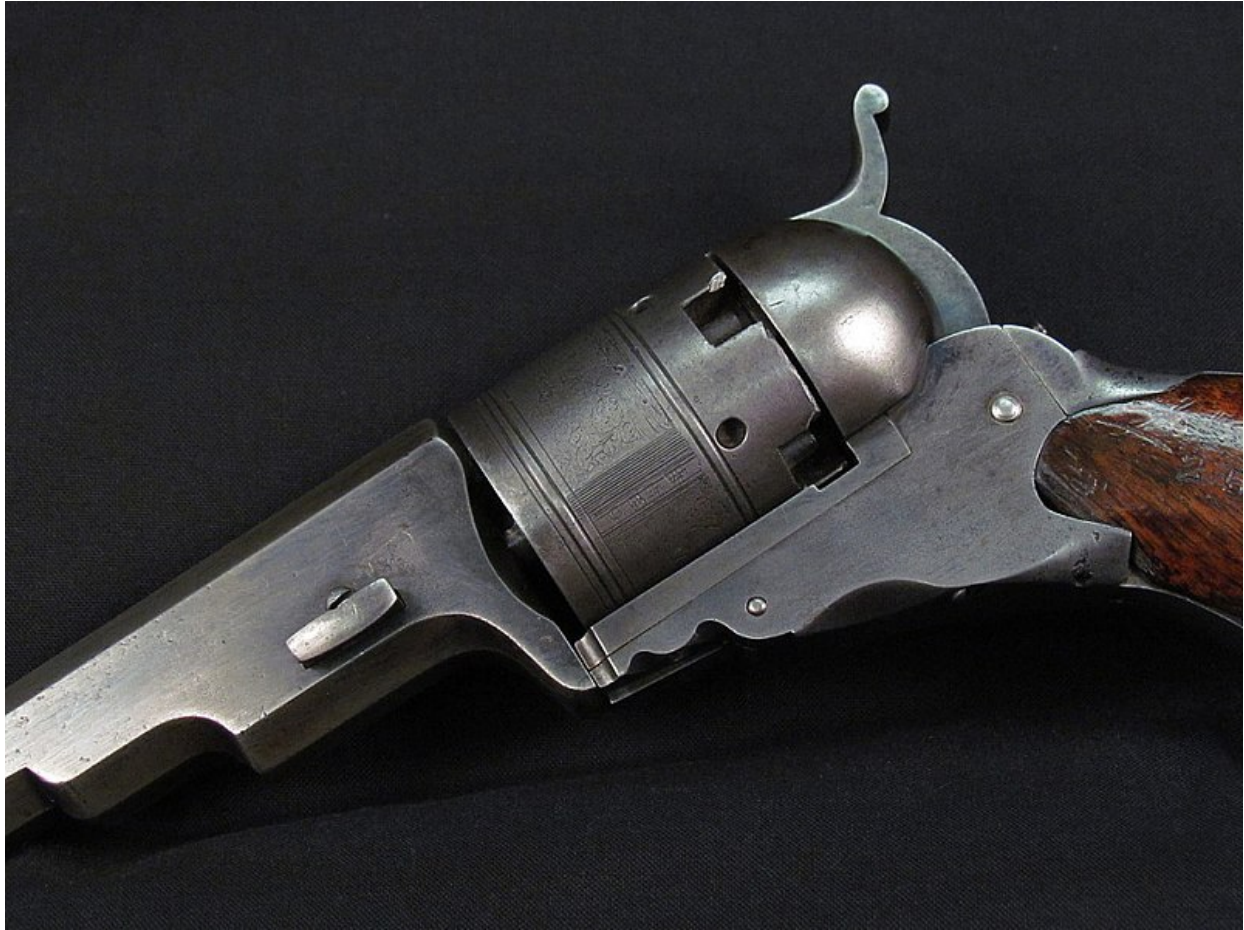
Rachel Plummer was taken captive by the Comanches in the Republic of Texas in 1836. In her Narrative, while discussing the buffalo, she wrote the following:

The Indians shoot them with their arrows from their horses. They kill them very fast, and will even shoot an arrow entirely through one of these large animals.²

Rachel Plummer, City of Houston, Republic of Texas, 1839

The principal weapon of the Texas Rangers in the 1830's was anything but "very fast". Their muzzle loading long guns required 17 steps and took 30 seconds to reload.³

In June of 1844 fifteen Texas Rangers engaged seventy-five Comanches at Walker's Creek. This battle was different. The Rangers were armed with new Colt revolvers.



Colt Paterson Revolver, same as used by the Texas Rangers at the Battle of Walker's Creek. (Photo credit:

https://commons.wikimedia.org/wiki/File:Colt_Holster_Model_Paterson_Revolver_No.5-06.jpg Author National Museum of American History (Licensed under CC0 1.0 Universal (CC0 1.0) Public Domain Dedication).)

This was the first time a repeating firearm would be used in battle. This was the first time that the quick and deadly bow would be out-matched by a new and more terrible weapon. When the battle was over one ranger and twenty Comanches were dead.⁴

It is ironic that a later model of the Colt revolver would become known as the Peacemaker. The work of the first Peacemaker was done. It had triggered an ancient population expansion that carried on through a world-wide migration. It had forever altered the arc of human history.

It is perhaps a fair assumption that, without the bow-and-arrow, Africa would have remained populated, as it had been for 250,000 years, by small bands of hunter-gatherers. And Europe would have remained the Land of the Neanderthal. And there would be no cell phones,...

Notes

It you torture the data long enough, it will confess. -- Roland Coase

In the bathtub of history the truth is harder to hold than the soap, and much more difficult to find. -- Sir Terry Pratchett

AFRICAN MIGRATIONS

A 210,000 year old partial and likely modern human cranium found in southern Greece.

1. Katerina Harvati et al., "Apidima Cave fossils provide earliest evidence of Homo sapiens in Eurasia" *Nature* Vol 571 (July 2019): 500.

Neanderthals evolved in Europe 400,000 years ago and remained until 40,000 years ago.

2. David Reich, *Ancient DNA and the New Science of the Human Past* (Vintage Books, 2019): 6.

Evidence of Neanderthals and Moderns in the Levant 120,000 years ago.

3. Rainer Grun et al., "U-series and ESR analyses of bones and teeth relating to the human burials from Skhul" *Journal of Human Evolution* 49 (2005): 316-317, 332.

Evidence of Neanderthals beginning to disappear in the Levant 55,000 years ago.

4. Osbjorn Pearson et al., "A Partial Neandertal Foot From the Late Middle Paleolithic of Amud Cave, Israel" *PaleoAnthropology Society* (2020): 98, 113, 116.

Evidence of Moderns in the Levant 55,000 years ago.

5. Israel Hershkovitz et al., "Levantine cranium from Manot Cave (Israel) foreshadows the first European modern humans" *Nature* (2015): 1.

DNA evidence shows that the exit from Africa was through Egypt and the Sinai.

6. Luca Pagani et al., "Tracing the Route of Modern Humans out of Africa by Using 225 Human Genome Sequences from Ethiopians and Egyptians" *American Journal of Human Genetics* Vol 96 Issue 6 (June 2015): Conclusion.

The Migrants and Neanderthals interbred in the Near East.

7. David Reich, *Ancient DNA and the New Science of the Human Past* (Vintage Books, 2019): 40.

Neanderthals hunted in packs.

8. Lorraine Boissoneault, "Neanderthals Hunted in Groups, One More Strike Against the Dumb Brute Myth" *Smithsonian Magazine* (June 2018).

New discoveries and research increasingly reveals that Neanderthals were basically human.

9. Susan Peeters et al., "Neanderthals as familiar strangers and the human spark: How the 'golden years' of Neanderthal research reopen the question of human uniqueness" *History and Philosophy of the Life Sciences* (July 2020): Abstract.

Neanderthals were a danger to big game and to themselves.

10. Nicholas R. Longrich, "[Did Neanderthals go to war with our ancestors?](#)" *BBC Future* (November 2020).

Neanderthal javelins are over 300,000 years old.

11. "Schöningen spears" *Wikipedia*,
https://en.wikipedia.org/wiki/Sch%C3%B6ningen_spears (Accessed 11/09/2021).

Only a small wave of migrants departed Africa 55,000 years ago, likely fewer than 2,500.

12. Brenna M. Henn et al., "[The Great Human Expansion](#)" *PNAS* (October 2012): Abstract.

55,000 YEARS AGO

All non-Africans have descended from one small migration.

1. Hua Liu et al., "[A Geographically Explicit Genetic Model of Worldwide Human-Settlement History](#)" *PubMed Central* (2006): Abstract, Discussion.

Interbreeding with the Denisovans was not a unique event isolated to a particular time or group of Migrants. Evidence of this is found in the DNA of modern South Asians, East Asians, Philippine Mamanwas, Indigenous Australians and Indigenous New Guineans.

2. James F. O'Connell et al., "[When did *Homo sapiens* first reach Southeast Asia and Sahul?](#)" *PNAS* (August 2018): Genetics.

***Helicobacter pylori*.**

3. Bodo Linz et al., "[An African origin for the intimate association between humans and *Helicobacter pylori*](#)" *PubMed Central* (2007): Abstract.

Neanderthals and the Migrants were two predators in the same ecological niche.

4. Nicholas R. Longrich, "[Did Neanderthals go to war with our ancestors?](#)" *BBC Future* (November 2020).

The European Neanderthal disappeared roughly 4,000 years after the Migrants arrived 45,000 years ago.

5. Tom Higham et al., "[The timing and spatiotemporal patterning of Neanderthal disappearance](#)" *Nature* (August 2014).

Neanderthals successfully hunted giant straight-tusked elephants, woolly rhinoceroses, mammoths and each other.

6. Lorraine Boissoneault, "[Neanderthals Hunted in Groups, One More Strike Against](#)

the Dumb Brute Myth" *Smithsonian Magazine* (June 2018).

7. Nicholas R. Longrich, "Did Neanderthals go to war with our ancestors?" *BBC Future* (November 2020).

THE INVENTION

A +60,000 year old bone arrowhead from Sibudu Cave, South Africa.

1. Jocelyn Rice, "Archaeologists Find the World's Oldest Arrowheads" *Discover* (December 2008).

Analysis of the Sibudu Cave bone arrowhead.

2. Lucinda Backwell et al., "The antiquity of bow-and-arrow technology: evidence from Middle Stone Age layers at Sibudu Cave" *Cambridge University Press* (April 2018).

1926 San hunting kit.

3. Marguerite Oosthuizen, "The description of an unusual hunting kit considered to be of Southern Bushman origin" *Killie Campbell Africana Library* (October 1977): 75, 84.

Sibudu Cave 64,000 year old stone arrowheads.

4. Marlize Lombard, "Quartz-tipped arrows older than 60 ka: further use-trace evidence from Sibudu, KwaZulu-Natal, South Africa" *Journal of Archaeological Science* (August 2011): Abstract.

Pinnacle Cave 71,000 year old arrowheads.

5. Erin Wayman, "Early Bow and Arrows Offer Insight Into Origins of Human Intellect" *Smithsonian Magazine* (November 2012).

Sibudu Cave 77,000 year old stone arrowheads.

6. Veerle Rots et al., "Pressure flaking to serrate bifacial points for the hunt during the MIS5 at Sibudu Cave (South Africa)" *PLOS* (April 2017): Abstract, Hunting with points mounted on shafts.

Small bladed arrowheads (Pitt Rivers Museum, Oxford, England).

7. J. Desmond Clark, "Interpretations of Prehistoric Technology from Ancient Egyptian and other Sources. Part II : Prehistoric arrow forms in Africa as shown by surviving examples of the traditional arrows of the San Bushmen" *Paléorient* (1975): 138.

Ancient bow makers were highly skilled.

8. Jim Hamm, *Bows & Arrows of the Native Americans* (Lyons & Burford, 1991): 13.

There are approximately 750 native tree species in North America.

9. "Trees of North America" *Trees Live Here*,
<http://northamericantrees.com/index.html> (Accessed 11/14/21).

Native Americans made use of some eight tree species to make their war/hunting bows.

10. Jim Hamm, *Bows & Arrows of the Native Americans* (Lyons & Burford, 1991): 14-22.

The properties of the wood dictate the shape of the bow.

11. Jim Hamm, *Bows & Arrows of the Native Americans* (Lyons & Burford, 1991): 14.

Bow stave preparation.

12. Jim Hamm, *Bows & Arrows of the Native Americans* (Lyons & Burford, 1991): 22-26.

Medieval English longbow staves were cured for 4 years.

13. Eric Faust et al., "HISTORICAL EVOLUTION OF THE BOW: LONGBOW VS. CROSSBOW" *WORCESTER POLYTECHNIC INSTITUTE* (May 2014): 20.

Cardinal rule of bow making.

14. Jim Hamm, *Bows & Arrows of the Native Americans* (Lyons & Burford, 1991): 28.

Hadza bow making.

15. Frank M. Marlowe, *The Hadza Hunter-Gatherers of Tanzania* (University of California Press, 2010): 85.

Bow strings.

16. Jim Hamm, *Bows & Arrows of the Native Americans* (Lyons & Burford, 1991): 82-86.

Arrow shafts.

17. Jim Hamm, *Bows & Arrows of the Native Americans* (Lyons & Burford, 1991): 89, 93-104.

Arrow fletching and arrowheads.

18. Jim Hamm, *Bows & Arrows of the Native Americans* (Lyons & Burford, 1991): 89, 105, 111-134.

Shaft sizers.

19. Jim Hamm, *Bows & Arrows of the Native Americans* (Lyons & Burford, 1991): 98.

Nez Perce bow.

20. Jack McNeel, "Death of Elmer Crow Is a Cultural Loss for the Nez Perce" *Indian-Country Today* (Sep 2018).

SUCCESS

Population size affects innovation growth and its retention.

1. Maxime Derex et al., "Experimental evidence for the influence of group size on cultural complexity" *Nature* (November 2013): 389.
2. Joseph Henrich, "Demography and cultural evolution: how adaptive cultural processes can produce maladaptive losses: the Tasmanian case" *American Antiquity* (2004): Conclusion.
3. MARIUS KEMPE et al., "An experimental demonstration of the effect of group size on cultural accumulation" *Durham Research Online* (August 2014): Abstract, Introduction.

U.S. Patent Office.

4. "U.S. Patent Statistics Chart Calendar Years 1963 - 2020" *U.S. PATENT AND TRADEMARK OFFICE Patent Technology Monitoring Team (PTMT)* www.uspto.gov/web/offices/ac/ido/oeip/taf/us_stat.htm (Accessed 11/15/21).

Isaac Newton quote.

5. "Sir Isaac Newton" *BBC*, <https://www.bbc.co.uk/worldservice/learningenglish/movingwords/shortlist/newton.shtml> (Accessed 11/15/21).

All people living today share a 320,000 year old common ancestor.

6. David Reich, *Ancient DNA and the New Science of the Human Past* (Vintage Books, 2019): 18.

Population expansion circa 80,000-60,000 years ago.

7. Paul Mellars, "Why did modern human populations disperse from Africa ca. 60,000 years ago? A new model" *PNAS* (June 2006): Abstract, Archaeological Evidence.
8. Carla Aimé et al., "Human genetic data reveal contrasting demographic patterns between sedentary and nomadic populations that predate the emergence of farming" *Molecular Biology and Evolution* (December 2013): Inferred Expansion Signals Predate the Emergence of Farming.

Oldest known evidence of the bow-and-arrow.

9. Veerle Rots et al., "Pressure flaking to serrate bifacial points for the hunt during the MIS5 at Sibudu Cave (South Africa)" (April 2017): Abstract.

New hunting techniques likely increased food supply.

10. Paul Mellars, "Why did modern human populations disperse from Africa ca. 60,000 years ago? A new model" *PNAS* (June 2006): Population Expansion.

HADZA

Modern hunter-gatherers in East Africa.

1. National Geographic Society, "Hadza" *National Geographic Society* (August 2019).

The Hadza are perhaps the direct descendants of all non-Africans.

2. Johannes Krause et.al, "First large-scale ancient genomes study from sub-Saharan African skeletons lifts veil on prehistoric populations" *Max-Planck-Gesellschaft* (September 2017): Hadza may be direct descendants of the group of humans that migrated out of Africa.

Hadza oral traditions.

3. R. Layton (Editor), *Who Needs the Past?* (Routledge, 1994): 53.

Hadza bows are extremely powerful.

4. Frank M. Marlowe, *The Hadza Hunter-Gatherers of Tanzania* (University of California Press, 2010): 84-85.

Hadza boys become expert hunters at an early age.

5. Frank M. Marlowe, *The Hadza Hunter-Gatherers of Tanzania* (University of California Press, 2010): 157.

EARLY MIGRATION OF THE BOW

Iraq (50,000 BP)

50,000 year old Iraqi Neanderthal.

1. Steven E. Churchill et al., "Shanidar 3 Neandertal rib puncture wound and paleolithic weaponry" *Journal of Human Evolution* (August 2009): 165.
2. Libby W. Cowgill et al., "Shanidar 10: A Middle Paleolithic immature distal lower limb from Shanidar Cave, Iraqi Kurdistan" *Journal of Human Evolution* (2007): 214.

Evidence of a violent death.

3. Steven E. Churchill et al., "Shanidar 3 Neandertal rib puncture wound and paleolithic weaponry" *Journal of Human Evolution* (August 2009): 163-167, 175.

Image of wound.

4. Steven E. Churchill et al., "Shanidar 3 Neandertal rib puncture wound and paleolithic weaponry" *Journal of Human Evolution* (August 2009): 167.

San arrow shafts.

5. J. Desmond Clark, "Interpretations of Prehistoric Technology from Ancient Egyptian and other Sources. Part II : Prehistoric arrow forms in Africa as shown by surviving examples of the traditional arrows of the San Bushmen" *Paléorient* (1975): 130.

Modern wood arrow shafts (5/16, 11/32, and 23/64 inch diameters).

6. Mark Vogel, "Bow Hunting With Wood Arrows" *Ross City Archery* (1980): How Spine Weight Affects Arrow Flight.

Dart and spear size.

7. Pierre Cattelain, "Hunting during the Upper Paleolithic: Bow, Spearthrower, or Both?" *Plenum Press* (January 1997): 215-217.

8. William R. Short, "Viking Spears" *Hurstwic* (2021).

45,000 year old damaged Italian blades (backed pieces).

9. Adriana Moroni et al., "Grotta del Cavallo (Apulia – Southern Italy). The Uluzzian in the mirror" *Journal of Anthropological Sciences* (2018): 142.

Arrowhead alignment.

10. Richard Dodge, *Thirty-three Years Among Our Wild Indians* (Archer House, 1959): 418-419.

Sri Lanka (48,000 BP)

Evidence of bone arrowheads.

1. Michelle Langley et al., "Bows and arrows and complex symbolic displays 48,000 years ago in the South Asian tropics" *SCIENCE ADVANCES* (June 2020): Abstract, Osseous hunting technologies & Discussion.

Prime age monkeys and squirrels were hunted.

2. Michelle Langley et al., "Bows and arrows and complex symbolic displays 48,000 years ago in the South Asian tropics" *SCIENCE ADVANCES* (June 2020): Introduction.

Arrow vs. dart velocities. (max. example: 198 f/s vs. 96 f/s).

3. Jim Hamm, *Bows & Arrows of the Native Americans* (Lyons & Burford, 1991): 107.

4. Geoff M. Smith et al., "When Lithics Hit Bones: Evaluating the Potential of a Multifaceted Experimental Protocol to Illuminate Middle Palaeolithic Weapon Technology" *Journal of Paleolithic Archaeology* (2020): Velocity and Kinetic Energy.

Italy (45,000 BP)

First known moderns in Southern Italy arrived with an African toolkit.

1. Adriana Moroni et al., "Grotta del Cavallo (Apulia – Southern Italy). The Uluzzian in the mirror" *Journal of Anthropological Sciences* (2018): 125, 150, 152-153.

The Italians and the Africans made use of the same type of arrowhead.

2. Marlize Lombard, "Quartz-tipped arrows older than 60 ka: Further use-trace evidence from Sibudu, KwaZulu-Natal, South Africa" *Journal of Archaeological Science* (August 2011): Abstract, Results.

3. Katsuhiko Sano et al., "The earliest evidence for mechanically delivered projectile weapons in Europe" *Nature Ecology & Evolution* (2019): lines 17-23, 42-47, 92-99.

Evidence is lacking as to how the first Migrants got to Southern Italy.

4. Adriana Moroni et al., "Grotta del Cavallo (Apulia – Southern Italy). The Uluzzian in the mirror" *Journal of Anthropological Sciences* (2018): 153.

Voyage to Australia.

5. Michael I. Bird et al., "Early Human Settlement of Sahul was not an accident" *Scientific Reports* (June 2019): Abstract, Introduction & Discussion.

Japan (38,000 BP)

The first migrants to Japan possessed the bow.

1. Katsuhiko Sano, "Evidence for the use of the bow-and-arrow technology by the first modern humans in the Japanese islands" *Journal of Anthropological Sciences: Reports* (December 2016): Abstract, Results, Discussion & Conclusion.

Timor Island (35,000 BP)

Ancient bone arrowhead near Australia.

1. Sue O'Connor et al., "Are osseous artefacts a window to perishable material culture? Implications of an unusually complex bone tool from the Late Pleistocene of East Timor" *Journal of Human Evolution* (January 2014): Abstract, Morphological features of the artefact, Consideration of the hafting mechanism.

Arrowhead insertion.

2. Jim Hamm, *Bows & Arrows of the Native Americans* (Lyons & Burford, 1991): 131-132

Possible hafting methods.

3. Sue O'Connor et al., "Are osseous artefacts a window to perishable material culture? Implications of an unusually complex bone tool from the Late Pleistocene of East Timor" *Journal of Human Evolution* (January 2014): Figure 5.

Western Russia (29,000 BP)

Ancient Russian arrowheads.

1. Pavel Yurievich Pavlov, "THE PALEOLITHIC OF NORTHEASTERN EUROPE" *Archaeology Ethnology and Anthropology of Eurasia* (March 2008): The Initial and the Early Upper Paleolithic.

2. Pavel Yurievich Pavlov,

"Стоянка Гарчи I - памятник костенковско-стрелецкой культуры на

Верхней Каме (Северный Урал)" *Federal Research Center, Komi Science Center Urals Division RAS Institute of Language, Literature and History Department of Archaeology* (January 2009): Fig. 6. Garchi I site. Stone assemblage.

North American arrowheads similar to the Russian arrowheads.

3. Robert M. Overstreet, *Identification and Price Guide To Indian Arrowheads* (Gemstone Publishing, 2005): Alaska (p.1142, 11,000 - 11,300 years old), Bering Sea Region (p.1134, 1000 - 2500 BP), Oregon (p.955, 3500 - 7000 BP), Pennsylvania (p.136, 600 -1300 BP), Tennessee (p.498, 1000 - 6000 BP), Arizona (p.882, 2300-3500 BP), Northern Mexico (p. 881, 1000 - 6000 BP), Nebraska (p.895,4000 - 6000 BP).

Ancient Texas projectile.

4. Michael R. Waters et al., "Pre-Clovis projectile points at the Debra L. Friedkin site, Texas—Implications for the Late Pleistocene peopling of the Americas" *Science Advances* (Oct 2018): Buttermilk Creek Complex horizon & Figure 5 (A).

Southern France (54,000 BP)

The Neanderthals made a successful comeback.

1. Ludovic Slimak et al., "Modern human incursion into Neanderthal territories 54,000 years ago at Mandrin, France" *Science Advances* (Feb 2022): Discussion.

The Migrants returned.

2. Ludovic Slimak et al., "Modern human incursion into Neanderthal territories 54,000 years ago at Mandrin, France" *Science Advances* (Feb 2022): Discussion.

Wolf-dog.

3. "Origin of the domestic dog" *Wikipedia*, https://en.wikipedia.org/wiki/Origin_of_the_domestic_dog: **Late Pleistocene wolf admixture:** *A Neolithic dog from Newgrange, Ireland "showed ancestry from a population of wolves that could not be found in other dogs nor wolves today. The mutation rates calibrated from both the Taimyr wolf and the Newgrange dog genomes suggest that the modern wolf and dog populations diverged from a common ancestor between 20,000 and 60,000 YBP."* (Accessed 2/18/2022).

AUSTRALIA

Captain Cook's voyage of 1768 -1771.

1. James Cook, "Captain Cook's Journal During the First Voyage Round the World" *PROJECT GUTENBERG EBOOK* (May 2005): [Land upon Possession Island].

Traders of the Torres Strait.

2. "Kaurareg" *Wikipedia*, <https://en.wikipedia.org/wiki/Kaurareg> (Accessed 11/08/2021).

Collapse of the Australian ecosystem.

3. Terri Cook, "Ecosystem collapse in Pleistocene Australia" *Earth: The Science Behind the Headlines* (May 2012).

Native Australian tree species.

4. "Species List for Australian Tree Identification Images and Descriptions" *AllCreativeDesigns*, <https://allcreativedesigns.com.au/pages/speciescommon.html> (Accessed 11/08/2021).

Australian bow wood.

5. Anecdotally, as posted by bowyers on the Internet, there are 12 native Australian trees that have been made into serviceable bows by modern bowyers. Brown Mallet *Eucalyptus Astringens*, Desert Oak *Allocasuarina decaisneana*, Brigalow *Acacia harpophylla*, Spotted Gum *Corymbia maculata*, Grey ironbark *Eucalyptus paniculata*, Red Ironbark *Eucalyptus sideroxylon*, Black wattle *Acacia mearnsii*, Soapwood *Alphitonia excelsa*, Australian Pine *Casuarina equisetifolia*, Lancewood (aka Ironwood, Neverbreak) *Backhousia myrtifolia*, Hickory Wattle, *Acacia implexa*, Watergum *Tristaniaopsis laurina*.

Liangulu hunters of Kenya.

6. Dennis Holman, *Massacre of the Elephants* (Holt, Rinehart and Winston, 1967): 35-36.

Draw weight of the Medieval English longbow.

7. Hugh D. H. Soar et al., *Secrets of the English War Bow* (Westholme Publishing, 2010): 15.

Importation of bow wood by Native Americans.

8. Jim Hamm, *Bows & Arrows of the Native Americans* (Lyons & Burford, 1991): 14.

Possible routes taken by ancient voyagers to Australia/New Guinea.

9. Michael I. Bird et al., "Early Human Settlement of Sahul was not an accident" *Scientific Reports* (June 2019): Figure 1.

Earliest known ancient site on Southwest Coast of Australia.

10. Alan Cooper et al., "When did Aboriginal people first arrive in Australia?" *UNSW Sydney* (August 2018): Long connection to country (note Devil's Lair).

Australia's megafauna.

11. Admin., "10 Prehistoric Giants of Australia" *Kickass Facts Encyclopedia* (March 2021).

Spearthrower experiment.

12. Geoff M. Smith et al., "When Lithics Hit Bones: Evaluating the Potential of a Multifaceted Experimental Protocol to Illuminate Middle Palaeolithic Weapon Technology" *Springer Link* (April 2020): Materials and Methods & Velocity and Kinetic Energy.

English longbow performance.

13. Hugh D. H. Soar et al., *Secrets of the English War Bow* (Westholme Publishing, 2010): 129-130.

Ancient Australian with a damaged right arm.

14. Steve Webb, "Who was Mungo Man?" *Office of Environment and Heritage* (2021).

15. Stephen Webb, *Palaeopathology of Aboriginal Australians: Health and Disease across a Hunter-Gatherer Continent* (Cambridge University Press, 1995): 47.

Evidence of the spearthrower predates the African Migration.

16. Matthew L. Sisk et al., "The African origin of complex projectile technology: an analysis using tip cross-sectional area and perimeter" *International Journal of Evolutionary Biology* (2011): Introduction, Discussion (Fig 4, Porc Epic) & Conclusions.

PEACEMAKER

Col. Richard Dodge quote.

1. Richard Dodge, *Thirty-three Years Among Our Wild Indians* (Archer House, **1959**): 420.

Rachel Plummer quote.

2. Rachel Plummer, *The Rachel Plummer Narrative* (Forgotten Books, 2018, Self Published, 1839): 100.

Fire rate of muzzleloader rifle.

3. Richard Kerr, *WALL OF FIRE -- THE RIFLE AND CIVIL WAR INFANTRY TACTICS* (U.S. Army Command and General Staff College, 1990): 20-22.

The Battle of Walker's Creek.

4. S.C. Gwynne, *Empire of the Summer Moon* (Scribner, 2010): 146-148.

About the Author

Lonnie Goff is a software engineer and inventor/co-inventor of 34 US patents. This is the first attempt at a work unrelated to engineering. Proceeds from this book will be donated to Our Lady of the Angels Mission Foundation in Sonoita, AZ.

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